

WHAT IS CLAIMED IS:

1. A transfer apparatus for transferring an object, comprising:
a gripper for at least one of (a) gripping the object at a first position and releasing said object at a second position proximate to a receiver and (b) releasing said object at a first position after gripping said object at a second position proximate to said receiver;
a measurement device configured to measure a relative position of said gripper with respect to said receiver in at least one direction,
wherein a relative position error is determined with respect to a desired relative position based on the measured relative position and the relative position of the gripper and said receiver is adjusted based on the reduction of the relative position error in the second position.
2. The transfer apparatus of Claim 1, wherein said object comprises a substrate and said receiver comprises a substrate holder.
3. The transfer apparatus of Claim 1, wherein said object comprises a mask and said receiver comprises a mask support structure.
4. The transfer apparatus of Claim 1, wherein the relative position of said gripper and said receiver is measured by measuring the relative position between a first reference point of said receiver and a second reference point of said gripper.
5. The transfer apparatus of Claim 1, wherein said measurement device comprises at least one sensor provided on said receiver and a first reference point is provided on said sensor and a second reference point is provided on said gripper or said object on said gripper.

6. The transfer apparatus of Claim 1, wherein said measurement device comprises at least one sensor provided on said gripper and a first reference point is provided on said sensor and a second reference point is provided on said receiver.

7. The transfer apparatus of Claim 1, wherein said measurement device comprises at least one sensor provided on a frame that is relatively stable with respect to said gripper and said receiver, and a first reference point is provided on said gripper or said object on said gripper and a second reference point is provided on said receiver.

8. The transfer apparatus of Claim 1, wherein said transfer apparatus comprises a mechanical docking structure that docks said gripper to a frame and said measurement device comprises at least one sensor provided on said frame that is relatively stable with respect to said gripper and said receiver, and a reference point is provided on said receiver.

9. The transfer apparatus of Claim 1, wherein a difference in relative velocity between said gripper and said receiver at the second position, is minimized.

10. The transfer apparatus of Claim 1, wherein a difference in relative acceleration between said gripper and said receiver at the second position, is minimized.

11. The transfer apparatus of Claim 1, wherein said measuring device is adapted to measure the relative position in at least two directions.

12. The transfer apparatus of Claim 1, wherein the relative position error is additionally determined by using information regarding the relative position of said object relative to said gripper.

13. A lithographic apparatus, comprising:
a radiation system configured to provide a beam of radiation;
a support structure configured to support a patterning device that imparts said beam of radiation with a desired pattern;
a substrate holder configured to hold a substrate;
a projection system configured to project said patterned beam of radiation onto a target portion of said substrate; and
a transfer apparatus for transferring said patterning device, wherein said transfer apparatus comprises:

a gripper for at least one of (a) gripping said patterning device at a first position and releasing said patterning device at a second position proximate to said support structure and (b) releasing said patterning device at a first position after gripping said patterning device at a second position proximate to said support structure, and

a measurement device configured to measure a relative position of said gripper with respect to said support structure in at least one direction,

wherein a relative position error is determined with respect to a desired relative position based on the measured relative position and the relative position of said gripper and said support structure is adjusted based on the reduction of the relative position error in the second position.

14. The lithographic apparatus of Claim 12, wherein the relative position of said gripper and said support structure is measured by measuring the relative position between a first reference point of said support structure and a second reference point of said gripper.

15. The lithographic apparatus of Claim 12, wherein said measurement device comprises at least one sensor provided on said support structure and a first reference

point is provided on said sensor and a second reference point is provided on said gripper or said patterning device on said gripper.

16. The lithographic apparatus of Claim 12, wherein said measurement device comprises at least one sensor provided on said gripper and a first reference point is provided on said sensor and a second reference point is provided on said support structure.

17. The lithographic apparatus of Claim 12, wherein said measurement device comprises at least one sensor provided on a frame that is relatively stable with respect to said gripper and said support structure, and a first reference point is provided on said gripper or said patterning device on said gripper and a second reference point is provided on said support structure.

18. The lithographic apparatus of Claim 12, wherein said transfer apparatus comprises a mechanical docking structure that docks said gripper to a frame and said measurement device comprises at least one sensor provided on said frame that is relatively stable with respect to said gripper and said support structure, and a reference point is provided on said support structure.

19. The lithographic apparatus of Claim 12, wherein a difference in relative velocity between said gripper and said support structure at the second position, is minimized.

20. The lithographic apparatus of Claim 12, wherein a difference in relative acceleration between said gripper and said support structure at the second position, is minimized.

21. The lithographic apparatus of Claim 12, wherein said measuring device is adapted to measure the relative position in at least two directions.

22. A lithographic apparatus, comprising:
a radiation system configured to provide a beam of radiation;
a support structure configured to support a patterning device that imparts said beam of radiation with a desired pattern;
a substrate holder configured to hold a substrate;
a projection system configured to project said patterned beam of radiation onto a target portion of said substrate; and
a transfer apparatus for transferring said patterning device, wherein said transfer apparatus comprises:

a gripper for at least one of (a) gripping said substrate at a first position and releasing said substrate at a second position proximate to said substrate holder and (b) releasing said substrate at a first position after gripping said substrate at a second position proximate to said substrate holder, and

a measurement device configured to measure a relative position of said gripper with respect to said substrate holder in at least one direction,

wherein a relative position error is determined with respect to a desired relative position based on the measured relative position and the relative position of said gripper and said substrate holder is adjusted based on the reduction of the relative position error in the second position.

23. The lithographic apparatus of Claim 21, wherein the relative position of said gripper and said substrate holder is measured by measuring the relative position between a first reference point of said substrate holder and a second reference point of said gripper.

24. The lithographic apparatus of Claim 21, wherein said measurement device comprises at least one sensor provided on said substrate holder and a first reference point is provided on said sensor and a second reference point is provided on said gripper or said substrate on said gripper.

25. The lithographic apparatus of Claim 21, wherein said measurement device comprises at least one sensor provided on said gripper and a first reference point is provided on said sensor and a second reference point is provided on said substrate holder.

26. The lithographic apparatus of Claim 21, wherein said measurement device comprises at least one sensor provided on a frame that is relatively stable with respect to said gripper and said substrate holder, and a first reference point is provided on said gripper or said substrate on said gripper and a second reference point is provided on said substrate holder.

27. The lithographic apparatus of Claim 21, wherein said transfer apparatus comprises a mechanical docking structure that docks said gripper to a frame and said measurement device comprises at least one sensor provided on said frame that is relatively stable with respect to said gripper and said substrate holder, and a reference point is provided on said substrate holder.

28. The lithographic apparatus of Claim 21, wherein a difference in relative velocity between said gripper and said substrate holder at the second position, is minimized.

29. The lithographic apparatus of Claim 21, wherein a difference in relative acceleration between said gripper and said substrate holder at the second position, is minimized.

30. The lithographic apparatus of Claim 21, wherein said measuring device is adapted to measure the relative position in at least two directions.

31. A method of transferring an object via a gripping device, said method comprising:

gripping with said gripping device at least one of said object at a first position and releasing said object at a second position proximate to a receiving structure and releasing said object at a first position after gripping said object at a second position proximate to said receiving structure;

measuring a relative position of said gripping device with respect to said receiving structure in at least one direction;

determining a relative position error with respect to a desired relative position based on the measure relative position, and

adjusting relative position of said gripping device and said receiving structure to minimize the relative position error in the second position.

32. A device manufacturing method, comprising:

providing a beam of radiation using a radiation system;

imparting a desired pattern onto said beam of radiation by a patterning device;

providing a substrate that is held by a substrate holder;

transferring said substrate between a first position and a second position situated proximate to said substrate holder via a gripping device, said transferring including:

gripping said substrate at a first position and releasing said substrate at the second position or releasing said substrate at a first position after gripping said substrate at a second position;

measuring a relative position of said gripping device with respect to said substrate holder in at least one direction;

determining a relative position error with respect to a desired relative position based on the measure relative position, and

adjusting relative position of said gripping device and said substrate

holder to minimize the relative position error, and
projecting said patterned beam of radiation onto a target portion of said substrate.

33. A device manufacturing method, comprising:

providing a substrate;
providing a beam of radiation using a radiation system;
imparting a desired pattern onto said beam of radiation by a patterning device, said patterning device being supported by a support structure;
transferring said patterning device between a first position and a second position situated proximate to said support structure via a gripping device, said transferring including:
gripping said patterning device at a first position and releasing said patterning device at the second position or releasing said patterning device at a first position after gripping said substrate at a second position;
measuring a relative position of said gripping device with respect to said support structure in at least one direction;
determining a relative position error with respect to a desired relative position based on the measure relative position, and
adjusting relative position of said gripping device and said support structure to minimize the relative position error,
projecting said patterned beam of radiation onto a target portion of said substrate.